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Finance Pathways for Young Innovative SMEs: A Demand-Side Examination of Finance Gaps and Policy Implications for the Post GFC Finance Escalator

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Key Sentence

Young, innovative UK SMEs are developing successful financing strategies, using a mix of bootstrapping, collaboration and new emerging post-Global Financial Crisis finance escalator funding, which is heavily reliant on government interventions, but finance gaps still persist requiring more cohesive financing and support policy.

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Introduction

In the aftermath of the 2007-08 global financial crisis (GFC) many governments focused their policies on financing innovation as a key driver for economic recovery (Hall and Lerner, 2010; OECD, 2012; Wilson and Silver, 2013; Mazzucato and Penna, 2014; Lee *et al.*, 2015). Numerous studies examined the supply-side finance policy offer, with relatively few considering the demand-side (Eurostat, 2011; Mina *et al.*, 2013; Lee *et al.*, 2015) and adopting a qualitative approach (North *et al.*, 2013) required to understand business financing demand-side processes, decisions and deficiencies which many have requested (Mason and Kwok, 2010; ERC, 2013; Lee *et al.*, 2015).

This paper addresses the persistent problem of finance gaps for early and growth stage innovative businesses through a qualitative demand-side study of 40 UK businesses, exploring their '*pathways*' to external finance and including: first, their external financing requirements between 2011-14; second, their processes of accessing external finance to find out why they succeed or fail; and third, where they fail, how they overcome this. The study focuses on technology-based businesses with high growth market potential and differentiates between shorter and longer horizon innovation cycles, which may impact on access (North *et al.*, 2013). Furthermore, a unique pathways methodology is developed to explore supply-side and demand-side factors by bringing together theoretical elements of the business financing cycle (Berger and Udell, 1998) using a finance escalator model and a managerial resource-based view (RBV) relating to human and social capital (Barney, 1991). The paper aims to explain demand-side failure, pinpoint supply-side funding gaps and provide policy guidance.

The policy rationale for assisting innovative earlier stage businesses is supported by two key arguments. First, an established correlation with economic growth, associated with large-scale

econometric studies in developed economies (Lerner, 2010; Lerner and Tag, 2013). Recent international studies (Mina *et al.*, 2013; Demirel and Mazzucato, 2013 and 2010; Coad and Rao, 2010) suggest that their economic contribution is nuanced, favouring R&D with formal IP protection and skewed by a few ‘*superstar*’ high growth firms. Since Birch (1979) highlighted SMEs as job generators, governments have been preoccupied with finding and supporting the high growth SMEs which generate the majority of new jobs (OECD, 2002). UK policy has been spurred by evidence for a ‘vital 6%’ of SMEs that generate over half of new UK employment (Nesta, 2009a; ERC, 2014¹), allied to the potential role that young innovative SMEs could play in this (North *et al.*, 2013). Second, since the discovery of the Macmillan (1931) financing gap, it is recognised that young innovative businesses encounter information asymmetries in the markets for finance (Hsu, 2004; Hughes, 2009) due to insufficient trading records and intangible knowledge-based assets. This can make them too risky for debt finance and prohibitively expensive for equity investors to undertake sufficient due diligence for the relatively small amounts of finance they require, providing a rationale for government intervention (Murray, 2007; Lerner, 2010).

The need for governments to address the persistent gap in early stage innovation financing was heightened during the post-GFC environment. Business finance became more expensive and difficult to obtain in many countries due to bank credit rationing and the retreat to more secure later stage equity investing (Wilson and Silva, 2013; Eurostat, 2011), leading to widely held observations that difficulties in raising external finance for young innovative SMEs was particularly exacerbated and to a proliferation of government interventions. In the UK, many considered the finance escalator (Nesta, 2009) for these businesses was broken (Mason *et al.*, 2010; Gill, 2010; North *et al.*, 2013; Lee *et al.*, 2015). This paralleled UK Coalition Government (2010-15) efforts to rebalance the economy (HM Treasury and BIS, 2011), with

¹ ERC (2014) noted that Nesta’s original data excluded micro businesses (<10 employees), updating UK evidence for 2008-2013, found a ‘vital 1%’ of ‘growth champions’ with 0-50 employees generated 36% of net new employment.

greater focus on advanced manufacturing and high value export services where young innovative SMEs were perceived as an important driver to post-GFC growth.

The paper comprises three main sections. First, a theoretical discussion in relation to innovation, finance and the business development cycle, how this relates to the evolving post-GFC UK finance escalator model and the crucial role that management experience and the business resource base including external support and networking can play. Second, the research methodology and key findings are set out. Finally, the implications of the findings for policy, theory and further research are discussed.

Defining innovation

SME innovation can broadly be defined as the commercial exploitation of ideas (DTI, 1998), which various studies have quantified in terms of the scale and distribution of new or improved products, services and a range of business processes including improvements in organisation, structure, marketing, and activities such as R&D, training, and acquisition of machinery and equipment linked to innovation (e.g. BIS, 2013; 2014). However, as North *et al.*, (2001) suggest, the degree of innovation in terms of its potential market impact is crucial to this paper.

This suggests three key innovation drivers of economic growth that underpin this paper. First, significant technological advances in sectors associated with R&D expenditure, ‘high technology’, and patent and trademark registrations (Pavitt *et al.*, 1987; Thwaites and Wynarczyk, 1996; Bullock and Milner, 2003). Second, innovation ranges from ‘internally-significant’ where innovations are new only to the firm itself, to ‘externally-significant’ innovations which profoundly impact on global markets, economies, and societies (OECD,

2005). Third, the degree of innovation intensity relating to cost and duration of the R&D innovation cycle which progresses through initial concept, proof of concept, prototyping, market testing, to establishing a market presence. These factors will have varying impacts on the attraction of external finance, explored in the supply-side discussion.

Demand-side factors: Financing pathways, a Resource-Based View

Fundamental to this paper, we examine external financing requirements and explain theoretically why young innovative businesses may succeed or fail to access the external finance that they require. Where they fail, we examine factors that contribute and discuss whether such failure can be explained through demand-side factors.

Pecking order hypothesis (PoH) (Myers and Majluf, 1984) is a common explanation for businesses selection (priority tendencies) for using different types of finance, favouring internal finance over debt finance, with equity finance and loss of ownership share being least favoured, notably by family owned businesses (Hiebl, 2013; KPMG, 2014). PoH may be influenced by business resource-based factors such as managerial experience, knowledge and the role of external advice and information (Hirsch and Waltz, 2011). Berger and Udell (1998) subsequently provided a balancing supply-side hypothesis by incorporating asymmetric supply-side theory into a business finance life-cycle model, suggesting that as businesses become more established and less opaque to financiers, a wider range of financing options become available. Their theory underpins the finance escalator, providing a dynamic external financing supply map for each stage of the business development cycle. First, demand-side factors are assessed.

From a demand-side perspective, the SME external financing pathway for innovation can be viewed as stage specific, within the course of the business cycle (Churchill and Lewis, 1983) and resource-based in assessing external finance requirements and seeking access. External finance is defined as outside the existing investor base (typically founders, family and friends) and retained surplus for reinvestment. This requires a fusion of the pathway steps taken to consider financing requirements and the resource-based view (RBV) which seeks to explain why actions are taken. Koryak *et al.*' (2015) review entrepreneurial leadership and SME growth suggesting that the elements of growth capabilities involving management leadership, team diversity of human capital, organisational skills, strategic networking and venturing and dynamic absorptive capabilities are key factors in growth, but that more needs to be known about how they operate, particularly in relation to accessing finance.

Recent UK government studies (BIS 2010, 2012, 2014) adopt a linear pathway approach (Figure 1) tracing the steps taken from an initial trigger requirement for external finance (such as, R&D, recruitment, working capital, capital equipment), through assessing the amount and type of finance required, search procedures for appropriate providers, applying for finance, and outcomes which may result in full, partial or non-funding. The latter options may lead to further assessment of financing requirements which may result in project closure, scaling down or a further funding search.

(insert F1)

The RBV of innovative SME growth sees entrepreneurial preferences driven by their resources, including finance, hence assuming that the entrepreneur will seek external finance when project requirements necessitate fund raising (Barney, 1991). Heffernan's (2007) modified RBV growth model applies to the innovative SME's growth journey, but a life cycle approach also requires the assessment of the business's dynamic capabilities. This involves a

set of skills, knowledge, processes, procedures, organisational structures, decision rules and disciplines. It suggests that a greater degree of formalisation and planning can lead to improved success (Wang *et al.*, 2007), but within earlier stage SMEs this needs to be flexible and dynamic. Eisenhardt and Martin (2000) argue that dynamic capabilities are a set of identifiable and specific processes such as product development, strategic decision-making and alliancing which can be path-dependent. Teece (2007) links dynamic capabilities to entrepreneurial behaviour, giving rise to potential path dependency based on previous experience of external financing and the influences of those financiers (Hirsch and Waltz, 2011; Baldock, 2015).

Absorptive capacity is arguably a concept that captures dynamic capabilities over time, the key difference being an ability to exploit as well as acquire and act on information (Cohen and Levinthal, 1990; Zahra and George, 2002). Put simply, absorptive capacity is a firm's ability to acquire, process, and exploit information. Situations of uncertainty, such as the post-GFC environment, place a premium on a firm's ability to process information and adapt (e.g. financing models) or pivot (e.g. innovations) accordingly.

From a resource perspective, theoretically, small innovative firms may face finance gaps that arise out of information asymmetries. Innovative firms' resources are often intangible assets (such as intellectual property rights – 'IPR'), but these present evaluation and risk issues for potential funders. For example, credit providers will discount intangible assets and equity providers must judge the risk of such investments when information on market value is limited. However, such information gaps may be mitigated by higher quality of human and social capital.

This highlights the role of human and social capital in access to finance. The availability and cost of external finance is likely to vary with the degree to which businesses' commercial

transactions with financiers (whether bank debt, private equity or joint venturing) are embedded in social attachments. Embedded ties, established over time, provide private information benefits that can channel resources and motivate parties to find financing solutions that are not available through simple market transactions (Granovetter, 1985; Uzzi, 1997). It explains how integral social relations and networking can positively affect the allocation and valuation of financing resources, using exchange protocols associated with social, non-commercial attachments to govern business dealings (Uzzi, 1999). Thus, relationship banking (where a close relationship is developed) for example, may mitigate some of the information asymmetries. Alternatively, supply-side interventions, discussed below, may provide incentives that encourage more risk taking, allowing more 'distant' financing relationship.

These underpinning RBV and social embeddedness approaches to the innovative firm suggest that factors such as access to information and networks, skill sets of management and staff, ability to process information and to learn from experience all contribute to determining when an innovative firm will be aware of, and seek, different forms of external finance and their ultimate chances of application success. Deficiencies which are not remedied by external assistance are likely to result in demand-side failures (Mason and Harrison, 2004; Murray, 2007) and the need for effective remedial assistance through investment readiness programmes (IRP) and ongoing support that can maximise the most effective use of funding (Mason and Kwok, 2010; Baldock, 1998).

The supply-side and the evolving post GFC UK finance escalator

The supply-side finance escalator provides a key explanatory mechanism for the supply of external finance for young innovative businesses. It can pinpoint where financing gaps exist

and whether there is supply-side failure. SMEs external financing choices are constrained by the availability of different types of finance during early and growth stage development. The finance escalator (Nesta, 2009) utilizes Berger and Udells' (1998) business finance life-cycle model to map the different types of finance available to businesses during life-cycle stages.

Early stage financing spans activities from pre-start concept proofing to start-up R&D and prototyping through to early market piloting. The growth stage typically refers to the transition between early market activity and achieving an established market position, typically completed via trade sale, initial public offering (IPO) or management buyout (MBO) when investors receive their return (Deakins and Freel, 2012). The length of time taken to achieve this will be determined by the length and intensity of the innovation, availability of required external financing and market acceptance (Baldock and North, 2015).

From a risk perspective, supply-side providers face different degrees of risk that vary with the sector, stage and growth of innovative small firms. For example, with start-up innovative small firms there is greater market uncertainty than with later stage. As highlighted below, variable sectors give different innovative life cycles with different levels of risk. Some risks can be transferred through insurance (or protected by security), but as discussed above the risks associated with intangible assets (such as imitation) are difficult to evaluate. RBV suggest that small innovative firms have advantages when valuable resources are protected (that is through patents) and cannot be easily imitated.

Therefore, long horizon intensive R&D sectors, such as life/bio-science, advanced engineering and cleantech, with 10 to 15 year innovation cycles experience persistent patient capital financing gaps (SQW, 2009). Hall and Lerner (2010) suggest this is due to heightened information asymmetries relating to the raised levels of investor uncertainty, supporting

Gompers (1995) finding that VC investment in high tech is smaller in higher risk earlier rounds, indicating that interventions such as tax breaks can help mitigate through encouraging private investment. Rowlands (2009) estimated a UK early growth stage patient finance gap of £2m to £10m. North *et al.*, (2013) and Baldock (2015) contrast this with shorter horizon software and digitech sector innovations taking three years or less to complete, suggesting quicker potential returns are more attractive to investors and also more suited to current UK tax relief through the start-up Seed Enterprise Investment Scheme (SEIS) and early stage Enterprise Investment Scheme (EIS)².

Various studies (North *et al.*, 2013; Mason *et al.*, 2010, Gill, 2010) have used the finance escalator to highlight potential supply-side finance gaps, whilst others such as Harrison (2014) and Baldock and Mason (2015) have used it to track the changes in availability of finance, post GFC, in the UK. Recently highlights of the evolving UK finance escalator include: (i) the withdrawal of early stage bank debt finance (North *et al.*, 2013; Cowling *et al.*, 2012); (ii) the withdrawal of private VC from early stage and even early growth stage finance (Baldock and Mason, 2015; Mason *et al.*, 2010); (iii) the increasing role of public VC funding in early and early growth stage financing (Mason and Pierrakis, 2013; North *et al.*, 2013); (iv) the increasing role of grant funding in early stage finance, extending beyond initial proof of concept funding (Baldock and Mason, 2015; North *et al.*, 2013); (v) the emerging role of new and alternative forms of equity finance in early stage funding, such as through corporate sponsored accelerators and seed equity crowdfunding platforms (GLA, 2013; Collins *et al.*, 2014); (vi) the increasing incidence of bootstrapping/bricolage techniques and financing

² EIS is capped at £1m (£2m for knowledge intensive sectors*) and 30% share for individual investors per annum, offering 30% Income Tax relief and full Capital Gains Tax (CGT) relief if held for a minimum of 3 years. Companies are usually under 10 years trading with under 500 employees and total EIS is capped at £5m per annum and £12m in total (£10m per annum and £20m in total for knowledge intensive sectors). SEIS is capped at £100,000 and 30% share per annum for investors, offering 50% Income Tax relief and CGT relief if held for a minimum of 3 years. It is restricted to businesses with under 25 employees and assets up to £200,000 and is capped at £150,000 per annum (EISA, 2015; Hammond, 2017* denoting change to support knowledge intensive investment from April, 2018).

models including self-funding, consultancy income, and collaborative (e.g. licensing, joint venturing) arrangements (Mac an Bhaird and Lynn, 2015).

Government policy, post-GFC

The post-GFC environment witnessed widespread national government responses designed to stimulate innovation and economic recovery. The OECD (2009) featured six main types of policy response: (i) public research institutions and education programmes (e.g. Australia, US); (ii) loan guarantees, including the UK Enterprise Finance Guarantee; (iii) tax breaks, including R&D spend (UK, Netherlands); (iv) sector specialisation (e.g. health and the environment in the US and Netherlands); (v) recruitment support for key staff (Canada, Germany); (vi) structural measures such as public private collaborations to encourage private funding (France).

It is widely acknowledged that innovation policy requires a broad and holistic approach (Murray *et al.*, 2009; Hughes, 2009; Hwang and Horowitz, 2012; Mason and Brown, 2013) to establish an effective financing and support ecosystem. In the UK, the Coalition Government 2010-15, ring-fenced R&D funding at £4.6bn per annum³ (BIS, 2012a) including education, training, key sector (e.g. low carbon to meet climate change targets) and financing instruments.

This paper focuses on early and growth stage SME innovation financing instruments and investment readiness programmes (IRP) to bridge private finance gaps. Table 1 presents the key sources of UK government and EU public finance available to innovative UK SMEs in

³ This figure was frozen, but calculated by the OECD (2012) to represent a likely real terms loss of 10%

the period 2010-15 covering this study. Baldock and Mason (2015), Baldock and North (2015) and North *et al.*, (2013) provide detailed accounts of these grant, equity, loan and tax incentive schemes. A major issue they examine is the level of public funding additionality in providing and catalysing funding that would not otherwise have been available, as opposed to displacement and duplication of existing private funding (Leleux and Surlemont, 2003) and incidence of deadweight relating to agency failures in funding unsuitable businesses (Hall and Lerner, 2010; Lerner 2002).

The British Business Bank was established in 2013 to co-ordinate SME finance (Van der Schans, 2015), monitor finance gaps and developing financing instruments to create an effectively flowing UK finance escalator that encourages private investment and support service development (Lerner, 2010). However, a considerable array of relevant government finance is not within its remit. This questions whether this agency can achieve the effective cohesive role that Mazzucato and Penna (2014) and Breedon (2012) suggest that state investment banks, such as the German Kreditanstalt für Wiederaufbau (KfW) play and it may require further powers.

(Insert T1)

(Insert T2)

Developing an enhanced theoretical framework and research propositions

Drawing on the theories presented, Table 2 presents a unique generalised contemporary UK-wide finance escalator stages framework which is combined with a managerial RBV

including external advice and information to provide explanatory factors for the various pathways to finance taken by innovative businesses and their relative success in obtaining the external finance that they require. Focusing on the early and growth stages outlined, the paper examines four research propositions:

P1: Early and growth stage funding pathways will be differentiated, with greater success at later stages. The finance escalator suggests fewer options at earlier stages, with PoH indicating entrepreneurial financing preferences which may also restrict options, whilst the RBV suggests greater development of external finance ties, for example through the development of social capital, would lead to the expectation of greater speed and success in accessing finance.

P2: Pathways to external finance will be differentiated by innovation intensity, with greater success for shorter horizon innovation. The expectation is that longer (five plus years), more intensive, R&D innovation will require larger scale, more patient capital, suggesting a more complicated pathway.

P3: Pathways will be differentiated by prior management experience and external advice, with greater success for those with greater experience and more advanced networks. The RBV perspective suggests that previous management experience, networking connections, the existence of close relationships and the use of appropriate advice, would lead to quicker and more successful outcomes.

P4: Pathways will be affected by external finance gaps, with those experiencing finance gaps more likely to develop alternative financing approaches. Here the expectation is that, controlling for demand-side deficiencies, earlier stage and more

intensive long horizon innovation will reveal finance gaps, examples of alternative financing approaches and strong policy indicators, particularly for UK finance escalator development.

Methodology

Developing on the existing research base, a semi-structured management survey of 40 early and growth stage independent UK innovative businesses was undertaken. This enabled qualitative in-depth process insights, whilst also being sufficiently large-scale to provide useful quantitative data analysis. Businesses were purposively selected from a range of sources, including: previous interviews with technology based small firms (TBSFs), which could provide more precise selection and longitudinal data (10 cases); Dun and Bradstreet data on 3,300⁴ UK TBSF sector start-ups since 2005; and company data from UK science parks and accelerators.

In order to select the most appropriate businesses, the following selection criteria were used:

- (i) An innovation involving new or improved product, service or process activity had taken place in the last three years and was perceived by the surveyed manager to have national or international market impact.
- (ii) External finance had been required in the previous three years 2011-14 to enable the innovative activity to progress.
- (iii) Businesses were established at the time of the survey and had at least progressed from proof of concept to start-up stage and could be defined as either early stage with less than two years of trading record, or growth stage, either with at least two years trading record or with substantial market development external financing requirements.
- (iv) Businesses trading for more than five years, or with over 249 employees, at the time of their innovation financing requirement within the last three years were excluded.

⁴ In context, North et al (2013) indicate the UK technology-based SME population at 5.9%, representing circa 120,000 UK businesses (excluding self employed, unregistered businesses).

- (v) To account for potential differences between long and short horizon innovation, a broad range of sectors including typically longer R&D life science, cleantech and advanced engineering and shorter horizon software digitechs were included.
- (vi) To avoid regional data skew to the London-Oxbridge triangle where UK innovation and finance is concentrated (Baldock and Mason, 2015) widespread regional UK coverage was required.

The management interview survey took place in February 2015 with the chief executive or finance officer (CEO, CFO), either face-to-face on site (20) or via extended telephone interview (20). Interviews took an average of one hour and were recorded, transcribed and validated by respondents for accuracy. Data collected were also cross-checked against public records, including company websites, investor reports, annual company reports and Company House data.

The semi-structured survey instrument was piloted on three cases, including early and growth stage businesses and consisted of five sections: (i) business profiling, including; broad sector, UK region, age (establishment and trading), employment and sales turnover change and future forecast (for past and future three years) and management team (experience and structure); (ii) type of innovation (product, service, process) and length and intensity of the R&D cycle; (iii) the pathway process (Figure 1) to assess external financing need, select type of finance required and find suitable finance, including use of external advice and information; (iv) the application process for external finance, including success measures and, where applicable, further steps taken if partially or completely unsuccessful with initial applications; (v) an overall assessment of the UK early and growth stage finance experience, business impacts relating to financing model and performance and suggestions for improvements.

Cleaned, checked, transcribed data were entered into an Excel spreadsheet, enabling linear case-by-case process analysis and enabling content analysis (such as using word and phrase searches) to inductively build clusters of response types and segment them by key stage, innovation and management resource variables. This enabled proposition testing (Eisenhardt, 1989) and establishment of causal inference (Yin, 2003), the main unit of analysis being the business.

Addressing adverse selection

Major criticisms of small-scale qualitative research concern adverse selection and the generalisation of findings. Whilst careful sampling largely addresses this (Ritchie *et al.*, 2003), possibility remains that despite the selected sample containing robust surviving businesses, they may not be suitable for risk finance (whether funded or not). To assess this, the surveyed businesses were stress tested using a scorecard (un-weighted) of key determinants of earlier stage investment based on five key elements drawn from the literature:

1. Management track record and funding experience (Reid and Smith, 2001) allied to external networking connections and assistance (Denis, 2004; Lahti, 2014).
2. Market traction of the business in terms of sales track record or orders (Amit *et al.*, 1990; Sapienza and Amason, 1993).
3. Innovation scale in terms of degree of innovation, market scale and pivot-ability (Ries, 2011; Basulto, 2015).
4. Amount of external funding required in the round (North *et al.*, 2013).
5. Length of innovation horizon (Baldock and Mason, 2015; Baldock and North, 2015).

Each element presented a 10 point scale (elements 4 and 5 being inverse scores for the cost and length of innovation within each stage), providing in-group summary comparison total scores out of 50 ('T-scores') indicating, in the absence of a suitable comparator or control sample, surveyed businesses relative suitability for obtaining funding. The model (Table 3) has suitably robust explanatory powers. It demonstrates that lower quartile scores were significantly ($<.1$ level) associated with lower proportional success at receiving some or all funding and that upper quartile scores were significantly associated ($<.1$ level) with proportionally higher success at receiving all required funding without undue delays. Furthermore, it demonstrates that growth stage businesses (which had a higher mean T-score of +3.4) were significantly more successful than their early stage counterparts at obtaining external finance. Overall, these findings suggest there are businesses in the lower 'T-score' quartile, particularly in the early stage category, which are higher risk and potentially unsuitable for funding. Conversely, there are also two unfunded businesses (one early and one growth stage) in the upper quartile which may suggest that there is a funding gap. These findings will act as controls in order to enhance the robustness of the ensuing analysis.

(Insert T3)

Profile of surveyed innovative SMEs

Table 4 presents a profile of the 40 surveyed businesses by early and growth stage development, providing context for the stage analysis presented later. This demonstrates that all are currently innovating with half of the growth stage businesses involved in multiple innovations (three or more), often relating to variants of their main innovative technology platform. Focusing on the main innovation taking place, the vast majority relate to new or improved products and services, with process innovation more likely to relate to growth stage businesses that are seeking capital investment for acquiring and establishing their own R&D laboratory testing and manufacturing activities and in one case to build a demonstration biomass energy plant. The majority of surveyed managers assessed their main innovation to be significant to international markets. The nine early stage businesses assessing only UK market significance exhibited caution, suggesting that their software or engineering solutions were niche to particular UK sectors, but in several cases indicated potential wider international application. The more established growth stage businesses all aimed for global markets and in many cases already had footholds in these markets.

(insert T4)

To facilitating examination of the Rowlands' gap hypothesis (2009), longer and shorter horizon innovation is distinguished. As expected, Table 2 demonstrates that the selected technology-based businesses fall into two distinctive groups. First, 17 shorter horizon digital technology businesses including search engine operations (SEO), applications and cloud solutions, and also digital solutions for life sciences (meditech), financial services (fintech) and in engineering and cleantech. These software-based activities took between one to four years to develop to market, typically taking two years. Thus, an important distinction with

software development is that it can quickly reach markets. Once established there is an ongoing process of continuing refinements within the market (through updates and upgrades). A notable finding here is that two growth stage life science and cleantech businesses operate short horizon intermediary innovation services, collaborating with universities and R&D specialists to harness later stage technology, progressing to market or licensing within a two to three year period.

Second, 23 longer horizon innovation businesses, including: life science, aerospace, instrument engineering and advanced manufacturing, and cleantechs undertaking equipment and plant development. These innovations, involving extensive piloting, testing, trialling and regulatory approvals, could take 5-16 years and perhaps longer (given findings from early stage investors of lengthening investment horizons in the aftermath of the GFC downturn in the UK economy, Baldock, 2017). Typical median timescales are therefore likely to be best case scenarios and unduly optimistic for early stage businesses when compared with the responses of the more experienced growth stage managers.

As indicated in our theoretical discussion, assessing growth performance for earlier stage innovative businesses in conventional employment and sales turnover terms is notoriously problematic (Baldock and Mason, 2015), not least because of the uncertainty associated with the unpredictability of external funding and timescales to reaching and developing markets. Here some basic measures of growth during the last three years are provided to demonstrate how some of these businesses are making a difference and contributing to Nesta's (2009) 'Vital 6%' of employment and growth drivers in the UK economy. The early stage businesses are essentially micro businesses (1-9 employees) with a current median of 3.5 employees, only three employing 10 or more people. The median size of growth stage businesses is 13 employees. However, these include five medium-sized businesses (50-249 employees) and

one advanced plastics manufacturer that, since receiving innovation funding, has grown beyond the SME range. Overall, these businesses have created 600 new jobs in the past three years, with median increase of +2.5 jobs in the early stage and +11 jobs in the growth stage. The average increase of +61 jobs at the growth stage is skewed by a significant minority of five stellar businesses (including cleantech, life science and advanced manufacturing) generating between 25-165 new jobs in this period.

Assessment of sales turnover growth is restricted for early stage businesses, with only half trading at the time of the survey. However, from those that have started trading during the last three years, valid data (n=11) indicated median sales growth of £140,000 in this period, whilst for the growth stage businesses the median sales growth has been £585,000 (n=14). Two of the growth stage businesses are life science, long horizon innovators that have not yet reached the market. They are included in this stage because of the major step change investments that they have made, including an IPO and substantial private and corporate pharma equity investments (representing £200m and £16m respectively), leading to job growth and significant likelihood of future global growth.

Overall, it may be seen that some of these businesses are highly successful and making a positive difference to the UK economy. The next section examines the role of external finance and the finance pathways utilised by the innovative businesses.

Findings

The research findings presented explore the four main propositions concerning the pathways to external finance that innovative businesses take. They are presented in segmentation to

facilitate answering the propositions and to draw out the considerably different approaches to, and experiences with, external financing between the early and growth stages studied.

P1: Early Stage versus Growth Stage

Early stage businesses were quite evenly divided between the initially self-funded ('3Fs'), those established with R&D contract income whilst also seeking to undertake their own innovations, and those that had sought external finance from the outset. These contrasted individuals and small founder first time entrepreneur teams with no previous experience of seeking external finance with more experienced spin-out managers and serial entrepreneurs who "*knew from the outset that the company would be a vehicle for fundraising,*" or set out with a contract R&D approach knowing that "*early stage financing is difficult and time consuming to obtain.*"

Early stage businesses, particularly those without entrepreneurial fundraising experience, lacked formal discipline in their business and financial planning practices, making "*kitchen table decisions,*" presenting a picture of muddling through, iterative learning-by-doing practices. This resulted in wasted time seeking unsuitable types of finance, including bank debt finance, alternative crowd source debt finance (e.g. Funding Circle⁵) and private VC. These required "*proven trading records*" of at least two years in the case of debt finance and "*evidence of genuine market traction*" in the case of VC. Entrepreneurial preferences were in-line with the PoH (Myers and Majluf, 1984), notably including two family-owned businesses averse to equity finance (Hiebl, 2013): "*We are family run and don't want others interfering in managing our business*". However, the vast majority of surveyed managers (early and growth stage) would consider equity finance and many recognised it as "*the only suitable type*

⁵ Funding Circle is UK government backed peer to peer finance offering term loans up to £1m, £250,000 if unsecured, requiring a minimum 2 year trading record.

of finance available for risky pre-revenue businesses.” They suggested that the current UK supply of early stage finance largely consists of grant funding from Innovate UK⁶, LEP catalysts⁷, and Scottish Enterprise alongside funding from high net worth individuals (HNWIs), business angel syndicates, public and private seed VCs and accelerators, whilst a couple mentioned crowd sourced equity as a possible option, although none had applied (Table 4). Funding was mainly required for R&D, but also related to working capital, key staff recruitment, proof of concept (PoC), prototyping and marketing, depending on the status of early stage innovation progression towards early marketing. The funding required could be considerable, ranging from £25,000-£50,000 for initial start-up working capital and PoC work to £2-3m for intensive engineering and life science R&D. These findings support evidence of a changing post-GFC early stage UK funding escalator (Baldock and Mason, 2015) with increasingly heavy reliance on equity and grant funding (North *et al.*, 2013).

(insert T5)

A number of outcomes emanated from initial failure to secure external finance, with under half receiving all of the funding they required and a similar proportion only receiving part (Table 5). Partial success resulted mainly from grant offers requiring match funding⁸ and difficulties raising sufficient equity finance, with bank finance typically not available. Resulting outcomes included increased incidence of seeking external advice and assistance, which was already widely used by more experienced early stage managers, increased consideration of equity finance, increased incidence of opportunistic funding applications for grants and approaches for equity finance, increasing evidence of bootstrapping techniques and

⁶ UK government grant funding body (formerly the Technology Strategy Board). It includes sector catalysts (e.g. Biomedical Catalyst) to assist tech transfer and financing.

⁷ English Local Enterprise Partnerships (LEPs) with Regional Growth Fund (RGF) supporting start-up and early growth grants and advice

⁸ UK government grants offered through Innovate UK typically require 40% match funding

alternative financing strategies involving greater emphasis on R&D consultancy and seeking licensing solutions in order to share the costs of R&D. These are surviving businesses, characterised by their tenacity. It typically took three months to make an initial application, but for those that were partially or completely unsuccessful, this resulted in slowing down or temporary cessation of innovation, scaling down of operations and in the majority of cases a continuing search for funding, which typically took another two years. This finding supports North *et al.*, (2013) in their assertion that early stage UK innovation financing is typically very time consuming and costly in terms of management time and opportunity costs in lost contractor revenue. However, for these businesses the indication is that persistence can eventually be successful. Early stage businesses that are dynamic, willing to be flexible in strategies and capable of absorbing and adapting to secure resources are likely to be successful in securing suitable external finance (Zahra and George, 2002).

Growth stage businesses were far more formalised in their assessment of funding requirements, particularly where they already had angel and VC investors who required regular financial and business planning reporting. They were also far more willing and quicker to assess the need to engage and pay for external advisors, such as VC/PE finder services and IPO brokers. This formalised procedure was exemplified by an experienced life science CEO:

“When I took over as CEO we had a prototype device ... I took the decision that we needed to take that to market in order to validate the technology. I put together a strategic project plan to do clinical studies and worked with my finance officer and the management team to fully cost all the elements, salaries, overheads, equipment, clinical studies running costs, and the cost of the external regulatory advice. So, for instance, to do the clinical study we needed a clinical research organisation for about six months of their input, so we went out and

obtained quotes from a number of external companies and agencies to recruit for one-off tasks. I then took that strategic plan to the board. The process took about six months, relating to a requirement to raise £5 million to take the product to market.”

Growth stage businesses typically required considerably more funding than their early stage counterparts, ranging up to £12m for an advanced plastics manufacturer to undertake an MBO acquisition of a manufacturing plant. Their median funding requirement was £1m, although for several longer horizon R&D companies this represented an intermediate round for ongoing R&D and could be considerably higher for later stage testing and prototyping; for example, a substantive £2.2m capital investment to build a demonstration biomass energy plant. Market development is also an increasingly important form of investment, requiring sales staff recruitment and funding overseas offices. A rapid growth digitech CEO of a specialist SEO platform with a recently opened US office noted that *“the growth of this business is determined by the speed of increasing our sales team, which can then build up a larger customer base for us to provide ongoing services.”* The types of finance applied for are indicative of the larger scale risk finance requirements of these businesses, which relate more to VCs and business angel networks (BAN syndicates), rather than HNWIs, and also to private and corporate equity and IPOs for two life science businesses. In a couple of cases substantial bank finance was applied for, but even with the Enterprise Finance Guarantee (EFG)⁹, these relatively early trading businesses were rejected. Grant funding, mainly in the form of technology development grants from Innovate UK and EU Horizon¹⁰ funds, remain an important source of finance at this stage. These businesses have established good contacts with universities and research centres and mention how this collaboration is crucial to the success rates of applications. However, several managers mentioned that grant funding is disjointed and unreliable, with one life science CEO suggesting:

⁹ Enterprise Finance Guarantee (EFG) has 75% government guarantee on SME term loans valued up to £1.2m

¹⁰ Formerly known as EU ‘FP7’

“The current UK grant system is actually funding to fail by not providing successful applicants meeting all of their funding milestones with prompt further funding. Perfectly good projects run out of funding and are put on hold whilst further funding is sought. Since Innovate’s funding rounds only occur half yearly and may not offer a relevant funding call, delays in finding external funding can result in project delays or closures and loss of market primacy for the innovator, as competitors catch up.”

Whilst the initial application success rate of growth stage businesses was better than for early stage, this was to some extent due to more experienced managers being able to work with their current investors to obtain follow-on finance, or to assist in finding new funding sources. However, it was also due to a wider range of funding options available to these businesses, including the recently improved liquidity status of the UK AIM, demonstrating its fundraising role for innovative businesses (Baldock, 2015), and the success of well-established grant writing collaborations with universities. Furthermore, there were a couple of examples of joint ventures, forged by maturing working relationships, in one case with a manufacturer who invested £100,000 into prototype equipment for an advanced ‘icepig’ pipeline cleaning innovation and in the other case with a large pharma that could undertake later stage drug trials (an investment under licence, worth several million pounds).

The three businesses that failed to secure sufficient funding at the time of initial application are characterised by the change in funding type that they required for step-change investment. This included a cleantech business (‘T-score’ 19.3) requiring £2.2m to build a demonstration biomass plant, an advanced plastics manufacturer (‘T-score’ 28.7) requiring £12m to acquire a manufacturing plant and a life science R&D contractor (‘T-score’ 31), requiring £1m to refinance the business and develop their in-house innovative brain disease treatments. ‘T-

score' analysis demonstrates that the former was in the lowest quartile, representing a particularly high risk in terms of lack of trading record and intensive R&D financing requirements, whilst the latter two cases are in the upper quartile, which may suggest market failure. Failure to raise bank loans, which were unsuitable even with EFG, and government backed VC which was criticised by one CEO as "*acting with similar criteria to private VC and not investing in early growth stage businesses*", led two of these businesses to use external VC finders and embark on three year searches. One was successful in accessing government backed UK Innovation Investment Fund (UKIIF) VC alongside a mezzanine loan from a Czech bank, whilst the other (with the low 'T-score') eventually adopted a licensing model whereby their clients raise the £2m required, using asset-based finance to build their own biomass plants and then receive ongoing servicing under license. The third business continues to operate on a slow growth trajectory, relying on a mix of contract R&D income and grant funding, until such time as it can obtain more substantive bank or equity finance.

In summary, it is clear (Table 5) that more established growth stage businesses are considerably more successful at the initial application stage and also overall, despite their far greater external financing requirements. To some extent this supports the finance escalator's greater range and scale of finance available as businesses develop track records and become less opaque to financiers. However, the findings also suggest other factors influence success and failure, such as innovation intensity, management experience, external assistance and potential funding gaps relating to the availability of debt and equity finance.

Longer versus Shorter Horizon Innovation

Comparing the longer (5+ years) and shorter horizon (<5 years) innovation businesses, notable differences are revealed (Table 5) suggesting that at both early and growth stages

longer horizon innovation businesses experience greater difficulties in accessing external finance and that this is particularly the case for larger growth stage finance, supporting the Rowlands' gap hypothesis (2009).

At the **early stage**, longer horizon innovation businesses typically require larger amounts of external funding (median £200,000, compared to £150,000 for shorter horizon businesses) and appear far more likely to seek VC or even early stage corporate finance. The reason for this is the substantial overall size of external funding required for longer horizon projects which are considered in many cases to be "*beyond the reach of business angel syndicates.*" For example, several life science CEOs mentioned that their overall project cost requirements were in excess of £10-15m, requiring multiple rounds of funding. Whilst business angel syndicates could fund early stage investment of up to £500,000, they were unlikely to have the follow-on funding capacity for later funding rounds. Early stage corporate investment, such as from large pharmas, was considered, but few enter the market at this early stage. Notably, only a small proportion (one quarter) of early stage longer horizon businesses received all of the funding that they required. Examination of 'T-scores' for those not receiving any funding indicated that they were typically lower (mean 21) when compared to the completely successful short horizon businesses (mean 27.1), but that the main differentiating factor was the length of investment horizon score (mean difference 4.35).

This funding shortfall slowed development and led to additional interim funding round requirements or changing emphasis to undertaking more contract R&D for income, taking the business focus away from its own innovation development. In some cases, innovation process remodelling occurred, for example, a life science business that started licensing out their innovative 'nanogenic' treatments to small laboratories who could absorb the cost of testing and later stage trials.

At the **growth stage** the difficulties for external financing of longer horizon businesses appear most acute. Here, the high costs of extended R&D and prototyping or clinical testing are exemplified by the far higher median external financing requirements of longer horizon businesses (£1.6m) compared to their shorter horizon counterparts (£215,000). Again, the focus is on equity finance, mainly from VCs, but also including business angel syndicates in combination with VCs, corporate and private equity, and examples of joint venture sharing of innovation costs and an IPO. Bank debt finance was still not an option and those that applied were rejected, due to the large sums required (£1m and £12m¹¹) and the ineffectiveness of the EFG in these cases. Again, whilst growth stage businesses are more successful in obtaining external finance than their early stage counterparts, it is the longer horizon businesses that are less successful in obtaining all of the funding that they require and importantly they face considerably longer searches for their finance (a median of nine months to initial funding decision, compared to two months for their shorter horizon counterparts). Two long horizon businesses had not received any funding (one with an upper quartile ‘T-score’, which may suggest a finance gap).

A notable anomaly is a shorter horizon life science business requiring £7m growth stage investment that undertook joint venturing and IPO fund raising. It specialises in fast turnaround intermediary services, sourcing later stage university genetics research and developing new treatments for large pharmas to take to the market. This short horizon company shared many of the attributes of digitech companies, “*benefiting hugely from the Enterprise Investment Scheme [EIS]*” which had encouraged HNWI and angel syndicate investments. Conversely, a number of longer horizon CEOs argued that “*the SEIS and EIS*

¹¹ This case pre-dated the Business Growth Fund (BGF) established by five UK banks in 2011, although it exceeds the £10m fund limit.

investment ceilings are a drop in the ocean to our external funding requirements” and that “these tax break schemes do not offer sufficient longer term incentives for investors.”

The greater problems accessing external finance experienced by longer innovation horizon early and growth stage businesses caused delays to innovation of up to three years. They also encouraged revised business funding approaches, leading to increased self-funding evidenced by bootstrapping techniques in the earlier stages (e.g. personal credit and pension cash-out investment) and through R&D contract work and collaborations, notably for growth stage licensing arrangements which enabled innovation cost sharing between businesses alongside a dilution in the returns from the successful market adoption of the innovation.

Greater versus Lesser Management Experience and Resources

Our findings suggest the potential importance of management experience in taking a strategic and formalised approach and, also the information and advisory resources that management can call upon, to assess, find and successfully apply for external financing options. This highlights the relevance of the RBV approach. It demonstrates clear differences between the surveyed early and growth stage businesses, with Table 6 presenting the emerging hierarchy of management experience and external resources relating to the access to finance pathway processes of the surveyed businesses at each stage.

(insert T6)

Early stage businesses exhibit a high proportion of first time founders with no previous experience of applying for the grant and equity finance that is most suitable. They are, therefore, very reliant on external advice, training and collaborations. It is strikingly evident

that the quality and suitability of external advice is the key to successful external finance selection and application. Almost all early stage businesses used external advice and training, or collaborated with academic researchers or businesses to develop grant proposals, or find suitable equity financing sources, with many using combinations of approaches. Despite the extensive external assistance used, application outcomes were mixed, with half receiving only some or no funding (Table 5). Managers' explanations for these results mainly related to the quality of external assistance received:

“Accelerator advice was too generic, one size fits all, too theoretical ... and the people giving the advice hadn't done it themselves. It got us organised, but we failed to secure any funding from this and wasted a year.” Early stage engineering business founder.

“Assistance that we received from Entrepreneurial Spark, a Scottish Enterprise accelerator, has been most influential in terms of wiring a successful grant application and developing network and direct links to early equity stage bodies.” Early stage gaming software business founder.

One might expect serial entrepreneurs to be more successful, but the evidence is mixed. Some founders demonstrated absorptive capacity (Zahra and George, 2002), for example, by learning from past failure by adopting more realistic funding strategies which in the cases of two life science businesses involved *“slower organic growth supported by our own contract research revenue”* and *“sharing of innovation development costs through licensing out drug testing to other small laboratories.”* There were also several cases where early stage businesses improved their grant application writing by learning from past failures, or were successful because they collaborated with experienced academic grant writers. Some exhibited positive path dependency (Teece, 2007), being successful because they had forged

good links with equity investors, such as an aerospace spin-out, which was able to secure grant and matching VC funding (totalling £600,000) within a three month fundraising period. However, others who had not managed businesses in the sector, or sought equity finance previously, were unsuccessful, being slower to adapt, seek advice and, crucially, to find good quality assistance.

This underlines the importance of accessing suitable high quality advice, training and collaborators. For example, one academic life science founder highly praised Strathclyde University's one year entrepreneurial training programme which most importantly "*provided equity investor networking contacts and clear insights into how to raise funding.*" This founder was also recommended to appoint an advisory board and experienced chairperson for the business. However, as another life science founder explained, hiring suitable people is crucial:

"You want people who have got experience of setting up companies. Initially we received bad advice, including hiring a very senior, experienced CEO to run the business side of things. They have proved expensive and lacked the relevant connections in the industry and drive to succeed that we required."

The crucial point here is that, whilst IRP(s) are important in assisting with business planning, financials, presentation and pitching and negotiating potential deals (Mason and Kwok, 2010), to be effective it has also to introduce the businesses to suitable sources of finance through effective networks and relationships. Recent schemes such as the UK government's 'Growth Accelerator'¹² will only succeed if they create suitable financing network links, particularly with early stage equity finance.

¹² Operated by the UK Government's Business Growth Service for high growth potential SMEs

Growth stage businesses exhibited more developed, larger and more experienced management teams, typically including experienced Chief Finance Officers (CFOs), and almost half have non-executive directors (NEDs) or advisory chairs or boards. They are also more likely to pay for professional advisory services, including VC finders, financial lawyers and accountants and City brokers in relation to IPOs. These more formalised arrangements are often driven by the strict financial governance requirements that hands-on business angel and VC investors require (Baldock, 2015). This increasing level of financial management experience at the growth stage is reflected in the high proportion with previous experience obtaining suitable grant and equity finance and the higher level of successful applications for external finance (Table 5); findings supporting the Burger and Udell (1998) business financing cycle model and also the RBV approach (Barney, 1991). Furthermore, these managers exhibit clear path dependency characteristics influencing their external financing pecking order choices. For example, those with current equity investors would first inquire with them about further investment before seeking further similar types of equity which could be characterised by preferences for either angel or VC, or for private equity over public equity, supporting Baldock's (2015) findings. However, there was no evidence of the potential negative impacts of path dependency where CEOs might be forced by investors to take particular financing paths (Hirsch and Waltz, 2011). Moreover, there was awareness that although current investors would not desire dilution of their share value, successful development of the business was the overriding requirement for both investors and management.

Returning to the three longer horizon growth stage businesses, that initially failed to secure their required finance, confirms the importance of prior funding experience and the value of high quality advice. They required substantial funding (£1m to £12m) which could not be

supplied by banks and required the managers to seek equity finance for the first time. They all employed VC finders, but only one was successful and this took three years. The other two businesses revised their business financing models. One uses R&D consultancy revenue to match fund successful grant applications, whilst the other switched to a licensing operation requiring customers to make the capital plant investment. These examples of business pivoting through absorptive learning processes will slow down their progress and potentially reduce their growth prospects, but have enabled survival and progression.

Finally, it is notable that collaborative financing, forged by longer-term business and R&D relationships with academics has played an important role in financing growth stage businesses. Notable examples include a life science businesses that works with world leading UK academics in advanced drug discoveries that has “*a better than 50% success record in grant writing*” and an engineering R&D business that has “*joint-ventured with a well established German manufacturing supplier in developing innovative icepig, pipe-cleaning processes.*”

The influence of finance gaps on pathways

This pathways demand-side analysis reveals the strengths and weaknesses of the interviewed businesses. It indicates that many first time founders lack formal and coherent strategies for accessing appropriate forms of grant and equity finance and few early stage founders knew about crowd-source equity options at the time the research was undertaken. Furthermore, in addressing these demand-side deficiencies, the value of suitable high quality training and assistance is confirmed. These findings strongly support the need for IRPs, ongoing

mentoring and affordable finance finding services in order to produce a suitable pipeline of investible early stage businesses (Mason and Kwok, 2010; Mason and Brown, 2013).

However, taking these demand-side deficiencies into consideration, it is also apparent (from our ‘T-scores’) that there are potential funding gaps in the current UK financing escalator. These particularly relate to longer horizon innovative businesses at the early and growth stages. First, the study found that a high proportion of successful early stage grant applicant businesses (5 out of 17), mainly from Innovate UK, have been unable to find the required matching funding (typically 40%) from debt or equity sources and that this is concentrated amongst longer horizon innovation businesses (4 out of 9). They face particular difficulties obtaining bank or alternative crowd sourcing debt finance (e.g. Funding Circle¹³), as they do not have at least two years’ trading record. They also have considerable difficulties finding equity investors and contend that the current SEIS and EIS schemes are not sufficiently large or attractive enough for longer horizon investors; “*angel investors were all looking for short-term returns*”, whilst private VCs are “*like banks, averse to risk and want to see a proven track record, by which stage we don’t need their investment.*” In some cases, they have sought early stage corporate (e.g. pharma) equity and looked overseas to Europe and the US for this, but it is “*...rarely available for early stage finance and, where it is, it can be restrictive on market development.*” (see also Baldock and North, 2015) It was also evident that where equity funding was received, it was often insufficient and would lead to a drip-feed of further interim funding rounds. The amounts of funding required recorded in this funding gap ranged from £50,000 up to £1.6m.

Second, there is evidence suggesting a significant funding gap for longer horizon growth stage businesses seeking ‘series A-B’ funding rounds of £1m to £12m, suggesting an

¹³ Funding Circle’s £250,000 unsecured lending cap is relatively small for some longer horizon projects

enlargement of the Rowlands' gap (2009). For these businesses, the size of funding required in combination with their patient capital requirements and relatively early trading positions, means that bank finance remains difficult to access, even with the EFG, and that they are still too early stage for private VC. The UK banks' establishment of the Business Growth Fund (BGF) in 2011 has not sufficiently addressed this requirement as it offers between £1-10m finance to businesses that have achieved annual sales turnover of over £5m.

The existence of these two funding gaps can be highly damaging to the affected businesses. Delays in finding funding can take several years (Table 5) and this often results in management attention spent on fundraising rather than maintaining innovation progress, potentially allowing competitors to catch up (Baldock and Mason, 2015). The surveyed businesses are survivors, resilient and resourceful. There were some concerns that government and EU backed regional VCs were risk averse, "*operating like private VCs*" or simply did not have the scale of funding (individual investments typically being capped at £2m, Table 1) to meet the enlarged series A-B gap (Baldock and North, 2015). Alternatively, these businesses employ bootstrapping techniques to survive periods of external funding shortages (Mac an Bhaird and Lucy, 2015). This involves self-financing using directors' personal finance, working without wages and undertaking contract research for income. This study also found evidence of the importance of collaboration to fund innovation, with several businesses adopting licensing and joint venturing approaches to overcome their own external financing shortages.

Confirmation of changing demand trends

The findings from this study can be compared with the parallel study of North *et al.*, (2013) examining the financing of early and growth stage UK TBSFs between 2007-2010, spanning

immediately prior the GFC through to the height of the GFC recession. Whilst this is not an exact match, it contains 53 SMEs from similar sectors, with a similar balance of longer and shorter innovation investment horizons that had sought external finance. This reveals clear post GFC financing demand changes amongst these TBSFs: demand for bank loan finance declined from 47% to 13%; demand for VC finance increased from 23% to 43%; demand for HNWI/angel finance increased from 26% to 45%; demand for grant finance increased from 47% to 63%. Furthermore, whilst North *et al.*, (2013) found some cases of bootstrapping (8 per cent) and collaborative financing (4 per cent), the evidence from the current study is that these activities have increased (25 per cent bootstrapping and 18 per cent undertaking or currently considering JV/licensing arrangements).

Conclusion and Policy Implications

In conclusion, using a unique analytical framework approach combining finance escalator theory with a RBV approach of management experience and advisory networks, this paper has addressed four propositions relating to the external financing pathways of young innovative UK SMEs. Contemporary post GFC insight is provided into the changing nature of entrepreneurial financing demand preferences and evolving UK finance escalator supply for early and growth stage development, whilst also demonstrating the key roles of management experience, good quality advisory and finance finding services, collaborative financing, business absorptive capacity and adaptability. The study is limited by its demand-side focus, scale (in terms of quantitative robustness) and broadly cross-sectional approach. However, concentrating on viable surviving innovative businesses with national and global growth potential, it demonstrates that where adequate external finance is sourced, often with

government backed finance, high growth can be achieved and innovation finance policy appears vindicated.

Proposition 1 revealed key differences between early and growth stage businesses. Early stage businesses initially support the PoH, but demonstrate far greater acceptance of equity finance for early stage financing than anticipated, due to the retreat of bank debt finance from the UK early stage market. External financing at this stage is dominated by grant funding, HNWI and seed VC, but there are problems in finding grant match funding, leading to extensive innovation delays for some businesses. There is also evidence of bootstrapping and shifts towards collaborative financing approaches. Growth stage businesses have access to a far wider range of equity finance, as the finance escalator forecasts, including business angel syndicates, VC, PE and IPO, but still find bank debt finance difficult to obtain. However, their substantially higher funding requirements also lead to funding shortfalls and the need for collaborative financing arrangements through joint ventures and licensing.

Proposition 2 demonstrated that longer horizon business innovation is far more complex to finance than shorter horizon. Their larger scale funding requirements at both early and growth stages lead to 'drip-feed' equity investment, typically from VCs who have greater funding capacity than business angels, multiple funding rounds and in some cases to R&D contract income requirements or collaborative joint venture or licensing arrangements to share innovation costs. This problem is most acute for growth stage businesses, demonstrating an enlargement of the Rowlands' gap beyond £10m.

Proposition 3 supports the RBV hypothesis in overcoming asymmetric information barriers to external finance. There is clear evidence of superior success rates of growth stage over early stage businesses, with their larger, more experienced and better networked management teams

and more formalised approaches in obtaining external finance. They typically benefit from existing investors who drive formalisation, can offer additional finance, or facilitate pathways to other investors; evidencing positive path dependency. For earlier stage businesses, quality of advice and ongoing specialist support was most influential in finding and successfully applying for finance, whilst for businesses at both stages good quality collaborative relationships for grant writing are important. There is also evidence of absorptive capacity benefits, with early and growth stage managers learning from their mistakes by improving their funding applications and business financing models.

Proposition 4 presents two apparent gaps in the current UK financing escalator, which together with the need for better visibility of public and private VC and improved specialist advice and support, provide clear insight into where government policy could make a difference. First, early stage longer horizon innovation is struggling to find equity finance to match grant funds. Second, longer horizon growth stage businesses are struggling to find the scale of equity finance required.

To address these gaps there is a need for more coherent grant funding with better linkages to matching debt or equity schemes, through IRP and finance finding services, and which takes a whole of innovation life view (Hughes, 2009; Mason and Brown, 2013), with provision for follow-on funding and matching to avoid the current disjointed ‘funding for failure’ approach. With regard to improving equity finance provision, there is a perceived requirement for higher caps on SEIS and EIS and greater incentives for longer horizon investment, whilst the potential introduction of larger-scale government Enterprise Capital Funds under the increased £5m EU state aid cap could address the ‘series A-B’ requirements.

Addressing these persistent finance gaps clearly requires further research to examine efficient supply-side operation and changing demand-side preferences and requirements, as the post GFC UK finance escalator evolves. There are lessons here which extend beyond the UK, particularly in terms of the implications for a more enhanced oversight agency role, such as a state investment bank (Mazzucato and Penna, 2014). This would require a broader more direct interventionist role than is currently operated by the British Business Bank in the UK. Furthermore, with the increasing importance of collaborative funding, which crosses international borders, more could be done to catalyse this, with for example Innovate UK sector specialisation (e.g. developing the Bio-medical Catalyst model), bringing together academics/researchers, SME innovators and industry buyers and suppliers, extending internationally.

Further qualitative and quantitative research is warranted on niche sector innovative small businesses, to delve deeper into process issues, the resource base of human and social capital and to confirm successful strategies for securing external finance. Family-owned business may also be a special case that deserves further research.

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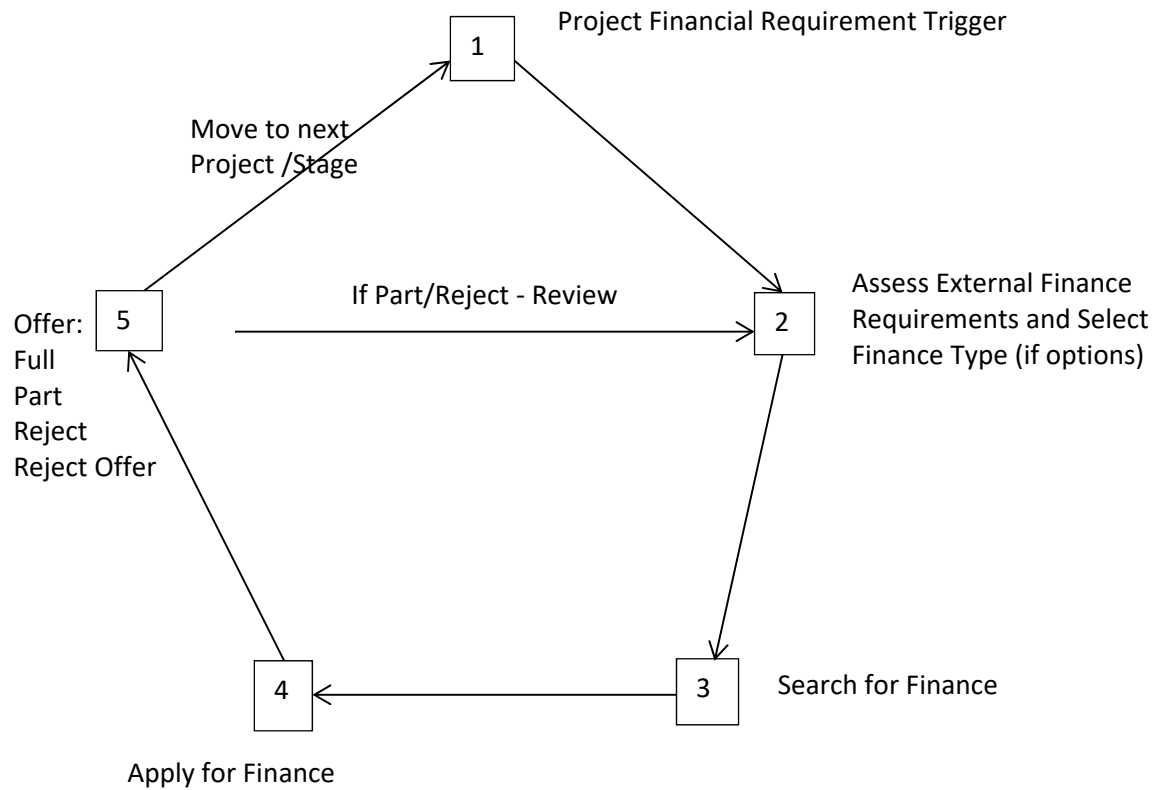
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Figure 1: Pathway to External Finance



Source: Adapted from BIS 2010; BIS 2012; BIS 2015; British Business Bank 2015

Table 1: Key Sources of EU and UK Government SME Innovation Finance in the UK, 2015

Type of finance	Funding Description	Administering Body
Tax		
R&D Tax Credits	SME scheme (<500 employees & £100m sales) for corporate tax rebate or cashback	HMRC
Seed Enterprise Investment Scheme	Start-up (<25 employees) investor tax relief, up to 50%: investor cap £100k, firm cap £150k pa	HMRC
Enterprise Investment Scheme (EIS)	Early stage (<500 employees) tax relief, up to 30%: investor cap £1m, firm cap £5m pa	HMRC
Venture Capital Trusts (VCTs)	VCs funded through EIS investing in SMEs (<£15m assets)	BBB
Grants		
Innovate UK (UKRI)	Various match fund grants: Knowledge Transfer Partnerships (<£80k), SMART awards (<£250k), Launchpad and Feasibility (<£400k), Collaboration and Catapult (£10m+)	Innovate UK
European grants	Horizon2020 and Eurostars grants (up to E300k at 50% match-funding)	EU
Regional Growth Fund (RGF)	Loans and grants through the £2.6bn RGF for English Local Enterprise Partnerships (LEPs)	BIS
Debt/loans		
Enterprise Finance Guarantee (EFG)	75% government guarantee on loans, overdrafts and invoice finance capped at £1m	HMRC
Business Finance Partnership (BFP)	£100m govt co-invest into invoice, supply chain, asset, mezzanine (growth loans) and P2P (e.g. Funding Circle, Zopa)	BBB
VC/equity		
Angel Co-investment Fund (ACF)	£100m evergreen angel co-invest fund, from 2011	BBB
Enterprise Capital Funds (ECF)	£840m co-invest VC funds, from 2006 (£400m boost, 2015)	BBB
UK Innovation Investment Fund (UKIIF)	£250m govt/EIF fund of funds for health, manufacture, green sectors, from 2009	BBB
Regional Venture Capital Funds (RVCFs)	North West (£190m), Yorkshire & Humber (£90m+), North East (£125m), East of England (£20.5m Low Carbon Innovation Fund) - range of loans and equity (£2m cap)	EU JEREMIE/ERDF, BBB
Devolved UK Governments	Scottish (£185m), Northern Ireland (£160m), Wales (£150m+) VC and loan funds (£2m cap)	EU ERDF/JEREMIE SIB/DETI/FW
Universities Innovation Fund	£160m (Higher Education Innovation Fund) and University Enterprise Zone Pilots (£15m), Knowledge Transfer Networks	HEFCE
Energy Entrepreneurs Fund (EEF)	£150m EEF and £10m Energy Innovation Fund	DECC
Export finance		
UK Export Finance	£1.5b scheme 2012-15 to assist export trade credit arrangements	UK Export Finance

Note 1 (acronyms): BBB - British Business Bank; BIS – Dept for Business Innovation and Skills; HMRC - Her Majesty's Revenue and Customs; DECC – Dept for Energy and Climate Change; DETI – Northern Ireland Dept for Enterprise Trade and Industry; ERDF – European Regional Development Funds; FW – Finance Wales; JEREMIE - Joint European Resources for Micro to medium Enterprises SIB – Scottish Investment Bank

Note 2 (research period): table details available finance during research period, please note BBB introduction of English Regional Funds in the North (Northern Powerhouse £400m), Midlands (Midlands Engine £250m), and West (Cornwall and Isles of Scilly £40m) from 2017-18 which may replace EU regional funds, depending on UK exit negotiations with the EU.

Sources: Adapted from Baldock and North (2015); BIS (2012a); British Business Bank (2015)

Table 2: Contemporary UK Finance Escalator and Financial Information Resource Base Framework

	Early Stage (<£5m)		Growth Stage (£2m-10m)		Mature Stage (£10m+)
	Pre-start	Start-up to early market development	Early growth and development	Later stage	Established maturity
Key resources of financial information and understanding	<p>Prior experience (e.g. experienced, serial entrepreneur)</p> <p>Social networks/peer group advice</p> <p>Public advisory sources</p>	<p>Prior experience (e.g. experienced, serial entrepreneur)</p> <p>Investor advice (NEDs)</p> <p>Social networks/ peer group advice</p> <p>Business mentors/ incubators/ accelerators</p> <p>Public advisory sources</p>	<p>Increasing management team experience</p> <p>Investor advice (NEDs)</p> <p>Accountants/VC finders</p> <p>Local business networks/peer group advice</p>	<p>Recruitment of specialist finance managers</p> <p>Investor advice (NEDs)</p> <p>Accountants/Lawyers/ Brokers/management consultants</p> <p>National/global networks</p>	<p>Highly specialised and expert finance teams/internal fund raising teams</p> <p>Accountants/Lawyers/ Brokers/ management consultants</p> <p>National/global networks</p>
Key sources of finance	<p>Internal funding (3Fs)</p> <p>Credit cards</p> <p>Personal loans</p> <p>‘Proof of concept’ grant funding (e.g. Innovate UK grants)</p>	<p>Internal funding (3Fs, consultancy income)</p> <p>Early stage business angels, syndicates /HNWIs</p> <p>Technology development grants (e.g. Innovate UK)</p> <p>Public and seed venture capital (VC)</p> <p>Crowd equity</p> <p>Accelerator finance</p>	<p>Re-invested profits</p> <p>Bank credit</p> <p>Business angel syndicates</p> <p>Public and private VC</p> <p>Peer-to-peer lending</p> <p>Technology development grants and innovation loans (Innovate UK)</p> <p>Joint ventures and licensing</p>	<p>Re-invested profits</p> <p>Bank credit</p> <p>Venture capital</p> <p>Potential exit, trade sale, MBO/MBI</p> <p>Corporate/institutional finance (private equity)</p> <p>Business Growth Fund (BGF)</p>	<p>Re-invested profits</p> <p>Bank credit</p> <p>Large scale venture capital</p> <p>AIM and stock market listing</p> <p>Institutional finance, private equity (PE)</p> <p>Government and commercial trade credit</p>

Source: Adapted from Nesta (2009a), Baldock and Mason (2015) and BIS (2015)

Table 3: Business Stress Test Total ('T') Scores by Funding Success

Total Sample (n=40)	T-Score Range	T-Score Average	Received some	Received all	All with no delay
Lower Quartile (n=10)	11.4 to 20.2	16.7	50%*	40%*	40%
Upper Quartile (n=10)	30.7 to 37.3	32.6	80%	80%	80%*
Total Sample (n=40)	11.4 to 37.3	25.2	72%	63%	57%
Early Stage (n=24)	11.4 to 33.3	23.9	63%	46%	42%
Growth Stage (n=16)	17.9 to 37.3	27.1	88%*	88%***	81%**

Note: *significant at beyond .1 level; **significant at beyond .05 level; ***significant at beyond .01 level

Table 4: Profile Characteristics of Surveyed Businesses by Stage

Stage:	Early stage (n=24)	Growth stage (n=16)
Innovation		
New/improved products/services	21 businesses	16 businesses
New/improved processes	9 businesses	13 businesses
Number of current innovations	1 (13) 2 (4) 3+ (7)	1 (7) 2 (1) 3+ (8)
Market potential impact assessment	UK (9) Global (15)	Global (16)
Shorter horizon <5 years	11 businesses	6 businesses
Range	1-4 years	1-3 years
Median	2 years	1.75 years
Sectors	digitech (7) life science (3) engineering 1	digitech (4) cleantech (1) life science (1)
Longer horizon 5+ years	13 businesses	10 businesses
Range	5-15 years	7-16 years
Median	7+ years	10+ years
Sectors	life science (5) engineering (5) cleantech (2) aerospace (1)	life science (5) engineering (4) cleantech (1)
Age of Establishment		
Range	1-10 years	3-13 years
Average	3.2 years	6.2 years
Median	2.5 years	5.5 years
Trading	12 businesses	14 businesses
Regional Location		
London, South East, East	12 businesses	10 businesses
Other UK	12 (8 North West, 2 East Midlands, 2 Scotland)	6 (1 North West, 2 Scotland, 2 East Midlands, 1 South West)
Current Employment		
Range	1-45 employees	3-350 employees**
Average	6.5	61
Median	3.5	13
Current Sales Turnover	11 businesses*	14 businesses*
Range	£15,000 to £1.9m	£300,000 to £160m**
Average	£892,000	£18.2m
Median	£140,000	£1.1m
Growth in the last 3 years		
Employment		
Sum	99	501
Range	-5 to + 22	-3 to + 165
Average	4.1	31.3
Median	2.5	11
Sales Turnover	(n=11)	(n=14)
Sum	£9.78m	£305.13m
Range	£15k to £1.9m	£0 to £160m
Average	£888,000	£21.8m
Median	£140,000	£585,000

Note: Data from valid survey responses, February, 2015

Figures in parenthesis represent number of businesses (n=)

* One trading business did not provide valid data; two growth stage businesses were not trading

** Size at time of survey, they were SME size businesses at initial funding round search

Table 5: Pathways to External Finance by Early Stage and Innovation Horizon

	Stage	Innovation Horizon		Stage	Innovation Horizon	
	Early stage (n=24)	Longer (n=13)	Shorter (n=11)	Growth (n=16)	Longer (n=10)	Shorter (n=6)
Main Reasons:						
R&D	13	7	6	6	4	2
Working Capital	6	3	3	1	1	0
Concept (PoC)	4	2	2	2	1	1
Prototyping/test	4	2	2	6	5	1
Staff/recruit	4	2	2	3	1	2
Marketing	5	2	3	5	4	1
Types Finance:						
Grants	17	9	8	8	4	4
Bank	3	1	2	2	2	0
HNWI/Angels	12	6	6	5	3	2
VC	7	6	1	10	6	4
Accelerator	1	0	1	0	0	0
PE/Corp	1	1	0	2	2	0
Joint Venture	0	0	0	2	1	1
IPO	0	0	0	2	1	1
Amount (£):						
Range	£25k to £3m	£40k-£2.5m	£25k to £3m	£40k-£12m	£120k-£12m	£40k-£7m
Median	£200k	£200k	£150k	£1m	£1.6m	£215k
Initial Outcome*:						
All	9	3	6	13	7	6
Some	10 (cond**)	7	3	1	1	0
None	4	2	2	2	2	0
Time to Outcome:						
Range	<1m to 3+ yrs	<1m to 3+ yrs	<1m to 1yr	<1m-2yrs	2mths-2yrs	<1m-6+mths
Median	3 months	3 months	3 months	3 months	9 months	2 months
If some/None:						
Scale-down	4	1	3	1	2	0
Slow down	14	9	5	3	3	0
Resume search	10 med 2 yrs	8 med 2+yrs	2 med 2yrs	3 med 3 yrs	3 med 3 yrs	0
Final Outcome*:						
All	11	3	8	14	8	6
Some	4	2	2	0	0	0
None	8	7	1	2	2	0

Note: * One early stage business had not received a grant application result

** Includes mostly grant cases (from Innovate UK) conditional upon match funding

Table 6: Management Experience and Resources Hierarchy by Stage

Management Experience Characteristics	
Early stage (n=24):	
First time founder	University spin-out, independent innovator/first time in business owner-management (12)
Corp spin-out manager	Experienced managing in sector, but not an owner-manager (3)
Serial Entrepreneur	Previous management experience in sector, investor director (9)
Training/advice user	IRP, entrepreneurial training, mentoring, incubator/accelerator, LEP/Gateway advice (17)
Small Management Team (i.e. more than founder innovators)	Founder and other director/investors, may have NED or oversight advisory board (8)
Funding experience	Experience of applying for suitable grant or equity stage funds (13)
Collaborative Funding	Working with academics, or licensing (6)
Growth stage (n=15*):	
Management Team	Clearly defined management team with CFO and board (11)
External Management	NEDs, advisory chairs/boards, investor input/reporting (7)
Advice user	VC/PE fundraisers, IPO brokers, finance lawyers (8)
Funding experience	Experience of applying for suitable grant or equity stage funds (12)
Collaborative Funding	Working with academic, licensing or joint ventures (5)

Note: figures in parenthesis represent businesses; *one growth stage case with insufficient valid data